Faculty of Cognitive Science and Human Development

PATTERN RECOGNITION USING NEURAL NETWORK : USER DEFINED IMAGED CLASSIFIER BASED NEURAL NETWORK USING SELECTED FEATURE

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PATTERN RECOGNITION USING NEURAL NETWORK: USER DEFINED IMAGED CLASSIFIER BASED NEURAL NETWORK USING SELECTED FEATURE

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ABSTRACT

PATTERN RECOGNITION USING NEURAL NETWORK: USER- DEFINED IMAGES CLASSIFIER BASED NEURAL NETWORK USING SELECTED FEATURE

Shirley George

This study is about pattern recognition using Artificial Neural Networks (ANNs). The purpose of study is to train the Multi- layer perceptron (MLP) to decide whether an image contains desired object or not. The analysis for MLP is important to investigate its capability in capturing the images pattern as well as the goodness of selected feature used in this project. Preprocessing of images is done to find the edge of the object in an image. The edge features are processed before feeding to the MLP.The preprocessing is implemented in C, C++ language and OpenCV. Dataset that used in this project is collected from the researcher's collection. Experiment is carried out for the network using NevProp3 Neural Network simulation tool. The study shows that the MLP network is suitable to classify the images based on selected feature.The best classification rate is 72.7%

ABSTRAK

PENGECAMAN CORAK MENGGUNAKAN RANGKAIAN NEURAL BUATAN: PENENTUAN PENGKELASAN IMEJ BERDASARKAN RANGKAIAN NEURAL BUATAN MENGGUNAKAN CIRI YANG DIPILIH

Shirley George

Kajian ini mengenai pengecaman corak menggunakan rangkaian neural buatan. Kajian ini bertujuan untuk melatih Multi-lapisan perceptron (MLP) untuk menentukan adakah imej mengandungi objek yang diingini ataupun tidak. Analisis untuk MLP penting untuk mengkaji keupayaan MLP untuk mempelajari corak imej dan kebaikan ciri yang dipilih. Pra-pemprosean dijalankan ke atas setiap imej untuk mencari sisi objek dalam setiap imej. Sisi objek diproses sebelum dijadikan input kepada MLP. Proses ini dilaksanakan dengan menggunakan Bahasa Pengaturcaraan C, C++ dan OpenCv. Kumpulan data dikumpul daripada koleksi penyelidik. Eksperimen telah dijalankan ke atas rangkaian neural dengan menggunakan perisian NevProp3, perisian simulasi rangkaian neural buatan. Parameter-parameter bagi rangkaian neural buatan dalam eksperimen yang dijalankan adalah tetap kecuali nilai momentum untuk menentukan prestasi rangkaian neural tersebut. Daripada eksperimen, didapati rangkaian MLP dengan satu lapisan tersembunyi menunjukkan prestasi yang baik dalam pengkelasan imej menggunakan ciri yang dipilih. Prestasi berdasarkan ketepatan purata mencecah nilai 72.7%.

CHAPTER 1

INTRODUCTION

1.0 Background

Object recognition is always being part of lives. Human beings, constantly recognize various objects such as people, buildings, and automobile.. There are several important questions which are related to this general. What is defined as an object? What need to be done to recognize something as an object? The goal of computer vision is to design a system that would capable to analyze scene and determine which items in a scene are relevant objects (Knutzon,n.d) The objects can be a face, a car, a dog or so forth. One of pattern recognition area is object detection. Object detection is a well known pattern recognition problem for examples, face and car detection.

The main challenge in object detection/recognition is the amount of variation in visual appearance. For example in cars detection, the cars are vary in shape, size, and coloring and in small details such as the headlight, grills and tires as well as light sources vary in their intensity (Scheinederman & Kanade, 2000) Therefore strategies must apply to cope with all this variation. As mentioned earlier, to recognize the particular objects, several important cues help to look for the particular object. Several methods are proposed such as Principal Component Analysis, Genetic Algorithm, Wavelet Transform and Neural Nets for feature extraction. These steps are utilized to extract number of features and training a classifier using the extracted features through the classifier's model (Sun et al., 2003). In general, images have the following features- colour, texture, shape, edge, shadows and temporal details. The features that most promising were colour, texture and edge. All these features were extracted is to know the image domain (characteristics) that would aid in the detection process.

Neural network could be defined as an interconnected of simple processing elements whose functionality is based on the biological neuron (Wan,2004).According to Stergiou (n.d), he suggested that neural network is suitable for prediction or forecasting needs such as weather forecasting, industrial process control, customer research data and more due to its ability in identifying pattern. Various networks have been proposed over the years for numerous areas such as object detection which is a two class pattern recognition problem. Besides that, neural network is widely applied in area such as machine

vision, pattern detection and recognition, virtual reality, data segmentation, data compression, data mining, text mining, artificial life, adaptive control, optimization and scheduling, complex mapping and more. Due to detect object and advances in technology, the scope of this project is training the neural network to produce outputs a binary value of NO (0) or YES (1), indicating whether there is any hand present in the image's window. Generally there are three main steps involved in training the neural network For instance, firstly, some of image analysis processing is applied such as image enhancement, normalize the pattern due to size, reduce the noise and so forth. Secondly, feature extraction is applied to represent the feature before feeding the neural network. The last step involves training a classifier to learn assign input feature and makes classification of images. This project is proposing a NevadaPropagation ver.3 (NevProp3), an ANN software package to simulate the ANN model.

1.1 Problem Statement

Object or Pattern recognition system reflects the current state of the field of computer vision (Petro & Bosdogianni, 2003).Pattern recognition or object recognition such as face recognition, text recognition and so on has attracted much attention because it has many possible applications in human interaction interfaces, automation access system control. One of the object recognition problems is to give knowledge whether an image of scene probably contains desired object. According to Hamada (2002), the first step for the problem is to segment the image into regions that

would presumably contain the desired object to classify a given region as "object container" or as "non object –container.

Object or pattern recognition in an image however is challenging because the variability in the pose, orientation, location and scale. Lighting conditions and conclusion and further variability also become the constraint for the task. Lighting condition dependent on the light source affect the appearance of the hand. Also the background which defines the profile of the hand is important and cannot be ignored. Occlusion where other object may conclude the hand has furthers the problem. There are also some of the differences appearance patterns of the hand such as skin colour and space- time variability of hand gesture. Also other structural component such as watch, telephone, table and sofa add to this variability,

Figure 1.1: Examples show the the variability of the hand in the images due to different factors like pose, lighting, background and occlusion.

In this project, there are few questions need to be investigated in order to know whether the networks can classify the images in the neural network. For instance," Is any fixed rule use to classify images in neural network?" "How good the feature chosen to represent the hand in image?" and lastly" Can neural network learn the pattern of the hand images and non images?

1.2 Objectives and Scope

The main objective is to train the neural network to produce outputs a binary value of NO (0) or YES (1), indicating whether there is any hand present in the image's window. Other objectives of this project are to evaluate the goodness of the edge feature based on the neural network's accuracy and make evaluation the performance of the trained neural network in accomplishing the classification task. This research is focuses on human hand as an object in the image. The feature used for the classification are hand region pixels which present the edge of hand. There are two specific objectives in this project.

a) To uses supervised learning model to learn the selected feature (edge feature) and make classification of the images into two disjoint classes: (1) hand image, (2) non hand image.

b) Using MultiLayer Perceptron (MLP) through backpropagation learning algorithm. Simulation is done in NevProp3.

c) To evaluates the performance of trained neural network in classification using the selected feature (edge feature)

The scope of this study focuses on specified ANN model as mentioned earlier which is feed forward backpropagation network model (BP).The network model will be trained.

The trained network from the training phase will be tested on testing set to proof its ability in classifying images pattern. Then the performance of the trained neural network will be evaluated. To reduce the variability problem in the

classification task such as mentioned earlier, this project works with the images contain frontal view right hand with very slightly rotations only though the lighting condition can be varied and the hands are not occluded. In this project, hand is the desired object. But not all the part of human body evaluated as an object, only part of human hand evaluated. Figure 1.2 shows the part of human hand which researcher defines as 'object' for this project.

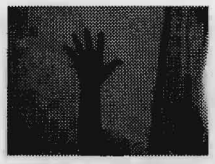

Figure 1.2: Example image that contain 'object' to be determined its existence in the static image

1.3 Significance of Study

This project is to implement the classification of non hand images and hand images using back propagation learning algorithm which available in Nevada Backpropagation ver.3(NevProp3) based on selected feature(edgy feature) in this project. Evaluation of the performance of the trained neural network is useful to investigate its ability to capture the hand pattern as well as the logic behind the algorithm proposed in this project. The project also provides a basis steps description on how the neural network works as classifier or template matcher which can be extended such that the trained neural network can be incorporated into the hand detection/ recognition system. Therefore the results from this project can encourage for future work.

1.4 Synopsis

The content of thesis can be summarized as follows. Chapter 1 consists of overview of this project includes the definition of object detection and some of its related works, application of neural networks in some areas and its definition. Besides that, there are problem statements, objective of the study and scope of this project. Chapter 2 contains literature review about the neural network paradigms theoretically, approaches used in classification task and its related works. Reading these materials is important to get for better understanding of the existing system and the steps involved in the detection development. Prior knowledge is important in doing this thesis. Meanwhile in Chapter 3 discusses about the methodology and system design. Based on description of the methodology, user can understand the flow of the system and method used which undergo the development. This chapter also concern about the training using Nevprop3 ver.3.Chapter 4 discusses about the implementation processes and its performance analysis. Finally, the conclusion and recommendation for current and future research is in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews the pattern recognition basis, background of the neural network and neural network application in pattern recognition. Some other classification methods also been reviewed in this chapter

2.0 Pattern Recognition

"Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data. It encloses subdisciplines like discriminant analysis, feature extraction, error estimation, cluster analysis (together sometimes called statistical pattern recognition), grammatical inference and parsing (sometimes called syntactical pattern recognition). Important application areas are image analysis, character recognition, speech analysis, man and machine diagnostics, person identification and industrial inspection." (Pattern Recognition Group at Delft University of Technology, cited in "Pattern ", 2005, p.1).

2.0.1 Pattern Recognition System Process

According to Jesan (n.d) pattern recognition of an item involves three levels of processing three levels of processing. There are input filtering, feature extraction and classification.

2.0.2 Filtering

Filtering is a process where unwanted information or data from input. Depending on the application, the filter algorithm or method will change. For example, in finger print identification, each time scan the fingerprint through a fingerprint device, the scanned output may be different. The difference may be due to a change in contrast or brightness or in the background of the image. In order to process the input, need only lines in the finger print and filter out all the unwanted portion of the image and replace it with white background, thus the filter mechanism is needed. The clean finger prints with only lines with helps with the process of feature extraction.

2.0.3 Feature Extraction

Feature extraction is a process of studying and deriving useful information from the filtered input pattern. The transformation of signal or image raw data into higher-level characteristic variables. These may be general features, which are evaluated to ease further processing, or application-oriented, like those needed for image recognition (K.Bock, 1998). The derived information may be general features

which are evaluated to ease further processing. For example, in image recognition, the extracted features will contain information about gray shade, texture, shape or context of the image. This is the main information used in image processing. Some of the features extraction techniques are Fourier Transform and Wavelet, Neural Networks, Genetic Algorithms and Principal Component Analysis (PCA) (Addison et al., n.d).

2.0.4 Classification

Classification is the final stage of the pattern recognition. This is the stage where an automated an automated system declares that inputted pattern belongs to a particularly category. There are many classification methods in this field such as Neural networks, Support Vector Machine, Eigen Faces and Hidden Markov Model (Dewan and Sussino, 2000). Classification methods design is based on the following:

2.0.4.1 Template Matching

A set of patterns belonging to same pattern is stored in a classification system. When unknown pattern is given as input, it is compared with existing patterns and placed under the matching pattern class.

2.0.4.2 Properties of Pattern (Feature)

The common properties of pattern are stored in a classification system. When an unknown pattern is available, the system checks its extracted common property

against the common properties of existing classes and places the pattern/ object under a class, which has similar properties/pattern.

2.0.4.3 Clustering

Here, the pattern of the targeted classes is represented in vectors whose components are real number. So, using its clustering properties, the classification of unknown pattern is mush easier if the target vectors are far apart in geometrical arrangement. If they are nearby or any overlap in the cluster arrangement, more complex algorithms are needed to classify the unknown pattern. (Jesan, n.d). One simple algorithm based on the clustering concept is Minimum Distance Classification.

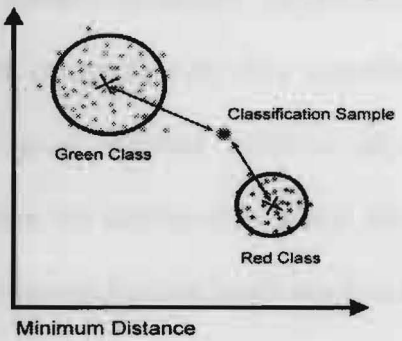

Figure 2.1: Classification using Minimum Distance

(Adapted from "Analysis", 2003)

This method computes the distance between the unknown pattern and the desired set of known pattern and determines which known pattern is closest to unknown and finally the unknown pattern is placed under the known pattern to which it has minimum distance. The pattern recognition approaches discussed so far are based on the direct computation through a machine which is more to math related

concept. The neural network approach to pattern recognition further discussed in next section. The neural approach applies biological concepts to machines to recognize pattern.

2.1 Neural Based Approach to Pattern Classification: Application to Object Detection/Recognition

2.1.1 Preliminaries

Neural network are composed of simple elements operating in parallel. Referring to Fausett (1994) these components are inspired by biological nervous system.Neural network as our brains system not only capable of parallel processing but also learning from experiences (example). An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons.The whole idea of interconnected billion of neurons in our brains and the mechanism inside our brain is modeled by neural net.

2.1.2 Background of Artificial Neural Network

2.1.2.1 Human Neurons

In the human brain, a typical neuron collects signals from others through a host of fine structures called dendrites. The neuron sends out spikes of electrical activity through a long, thin stand known as an axon, which splits into thousands of branches. At the end of each branch, a structure called a synapse converts the activity from the axon into electrical effects that inhibit from the axon into electrical effects